# Fast Local Emergency Evacuation Times (FLEET)

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*Rapid, Easy, Accurate Estimations of Evacuation Times*

# Agenda

- Intro to FLEET
  - RtePM
  - DHS, USACE participation
- Capability
- Entry demo
- Colorado Springs application
  - District 1
  - "Broadmoor Region"
- Q & A

# FLEET Summary

- Modification of RtePM providing increased precision in population selections and smaller roads

- RtePM is an online tool for rapidly estimating the time required to complete an evacuation

- Allows users to select the area to be evacuated using an online map by encircling the selected area

- Population census and road network information are automatically retrieved for the area selected

- Provides evacuation times in the event of both natural and man-caused disasters, acts of terrorism

- Introduced in August, FLEET already has approximately 70 users in 20 states plus DC

*Designed to be quick and acceptably accurate, Requires little advance training or expertise*

# RtePM and FLEET Applications

- **RtePM** now intended for large scale evacuations (hurricanes)
  - Hosted by MIT Lincoln Labs
  - Region-size evacuations
- **FLEET** is intended for local area evacuations

  - Hosted by ODU/VMASC
  - Wildfires, Flashfloods
  - Hazardous materials incidents
  - Terrorists attacks
  - Nuclear Power Plants
  - Special events/sporting events with large crowds

*Extremely versatile evacuation simulation*

# RtePM and FLEET

"RtePM has a storied history with a diverse set of developers through the past 15 years, including Johns Hopkins University Applied Physics Laboratory; Old Dominion University Virginia Modeling, Analysis, and Simulation Center (VMASC); and MIT Lincoln Laboratory.

In July 2021, MIT Lincoln Laboratory transitioned the current version of RtePM to the National Hurricane Program (FEMA, USACE, NOAA NHC). In addition, in the past year, VMASC adapted the updated version of RtePM to develop the Fast Local Emergency Evacuation Times (FLEET) model. **FLEET originated from the same source code as the RtePM model** and further enhancements have been made by VMASC.

The National Hurricane Program (NHP) has historically used RtePM to support the transportation modeling for Hurricane Evacuation Studies (HES). To develop an HES, the NHP leverages the **services and expertise of transportation engineer**s to model hurricane evacuation scenarios and **validate clearance time results**."

*Christina Finch –*
*FEMA National Hurricane Program Manager*

*Extensively Used Evacuation Simulation Code*

# RtePM and FLEET are

- Extensively tested and used evacuation simulations

- Independently validated to provide evacuation clearance times accurate to within 15%

- Easily learned and applied

- Exceptionally quick – computation times measured in minutes, not hours

- Fully functional using smart mobile devices

# RtePM and FLEET are NOT

- Substitutes for Emergency Evacuation Plans or Responses

- Replacements for regional or community transportation models or plans

- As detailed as transportation microsimulations

- Fire or weather models

*Designed to be quick and acceptably accurate, Requires little advance training or expertise*

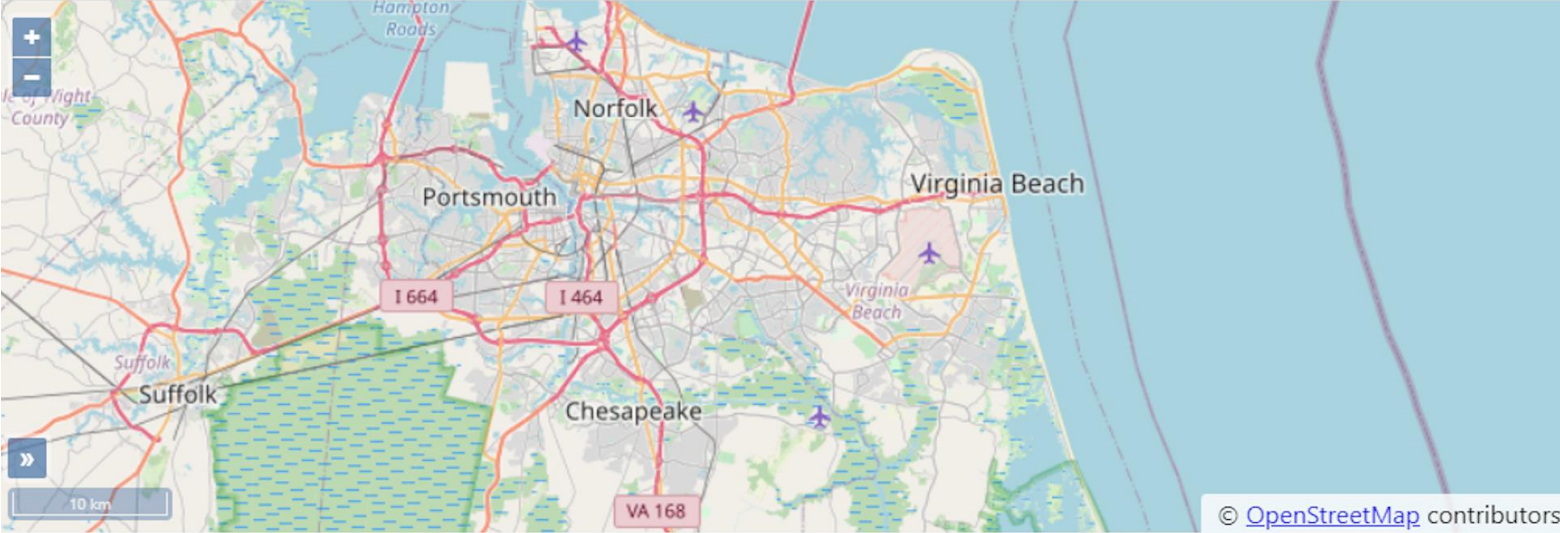# Key Considerations and Inputs

- Population:
  - Area to evacuate
  - Number of people (including seasonal or temporary population additions)
  - People per vehicle
- Road Network:
  - Road category (I.e. highway, major arterial, etc.)
  - Contraflow
  - Free-flow speed of road segments (including closing roads entirely)
  - Relative background traffic influences
  - Destination nodes for evacuation
- Behavioral:
  - Participation rate
  - Shadow evacuations
  - Response curve

*Consider these factors for each simulation run*

# FLEET Access and Sign-in

- **http://fleet.vmasc.odu.edu**
- Users must create a personal account
  - Personal accounts have user created passwords and created scenarios are saved in a private folder (can be made public)
  - Password protected files are not secure files – FLEET is not designed for use with classified information
- Records of <u>user access times and scenarios</u> are <u>monitored and recorded</u> to support program updates and value assessments

# FLEET Initial Screen



*Private initial screen with private and public scenario lists*

- Two primary areas assessed

  - District 1 (including three individual evacuation zones mimicking the Waldo Canyon fire evacuation report)

    - One scenario with traffic free flow speed on Rockrimmon Blvd reduced to 15 mph

    - Nine scenarios with seasonal traffic from Garden of the Gods

  - "Broadmoor Region" including seasonal population increases – 12 scenarios

    - Broadmoor Resort adds 14,000 people at 4.0 ppv (3500 vehicles)

    - Cheyenne Mountain Zoo adds 2000 people at 4.0 ppv (500 vehicles)

    - Seven Falls Park adds 400 people at 2.0 ppv (200 vehicles)

  - Two runs reduced traffic freeflow speed on W. Cheyenne Rd to 15 mph

  - Two runs reduced traffic on CO 115 to one lane in each direction

*Simulation scenarios created for Colorado Springs*

- Assumed 100% participation from residents in evacuation zones

- 1- and 2-hour response times

- 1.5 and 2.5 ppv

- With and Without Contraflow

- No travel from east Colorado Springs into evacuating areas

- Reduced I-25 traffic from non-evacuees

- Shadow evacuees from areas north/south of evacuating zones

*Simulation scenarios created for Colorado Springs*

# District One



N4
N2
N3
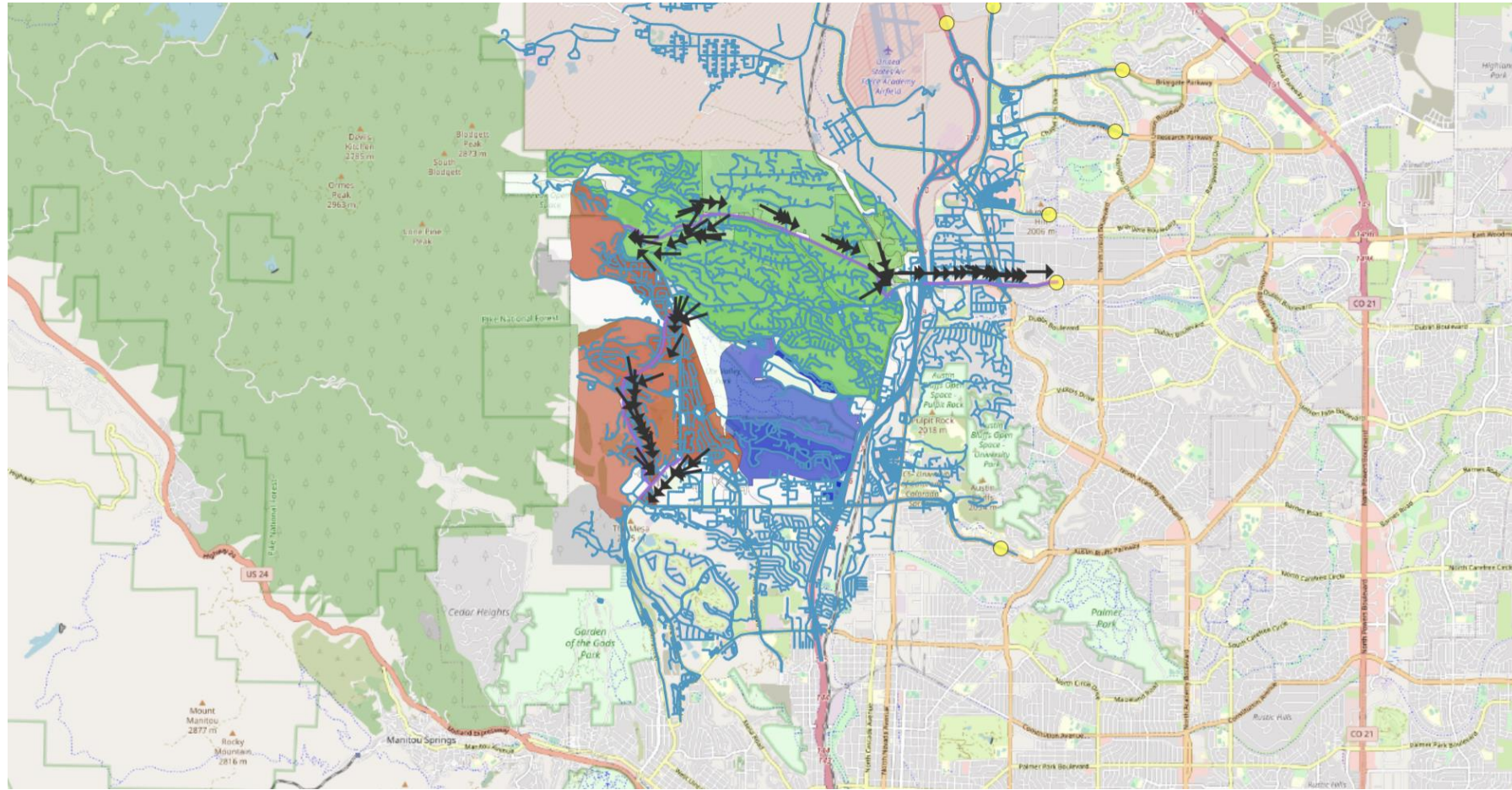
Black arrows show contraflow
routes and directions

Yellow nodes indicate evacuee
destination points

**Three Evacuation Zones in District One**

# District One Evacuations

Scenarios included:

- 100% resident participation rate

- All residents evacuating with same start and response times

- Zone 1-N4 (westernmost zone) leaving one hour earlier than zones 1-N2, 1-N3

- Zones 1-N4 and 1-N2 leaving one hour earlier than 1-N3

- Contraflow on/off

- 12,000 vehicles of background traffic from outside the evacuation zones

- Shadow evacuees

- No origin-destination travel westbound across I-25

- No incidents were modeled (conservative time assessment)

# District One Simulation Results

- Most impactful delays occur at east side bottlenecks
  - Contraflow moves evacuees further from the fire more quickly but does not necessarily reduce total clearance time due to delays at east boundary
  - Consider cost and best use of valuable emergency responders
- Shortest clearance time: **3:20**
  - 1-hour response
  - 2.5 ppv (higher ppv than expected)
  - No accidents/incidents or other road capacity reductions
  - Significant congestion and delay at multiple intersections remain
- **Best clearance time with 1.5 ppv increases to 4:20**
- Addition of Garden of the Gods vehicles greatly increased clearance times (by 2 to 4 hours)
- **Normal travel time** from northwest point to destination point = **15 minutes**
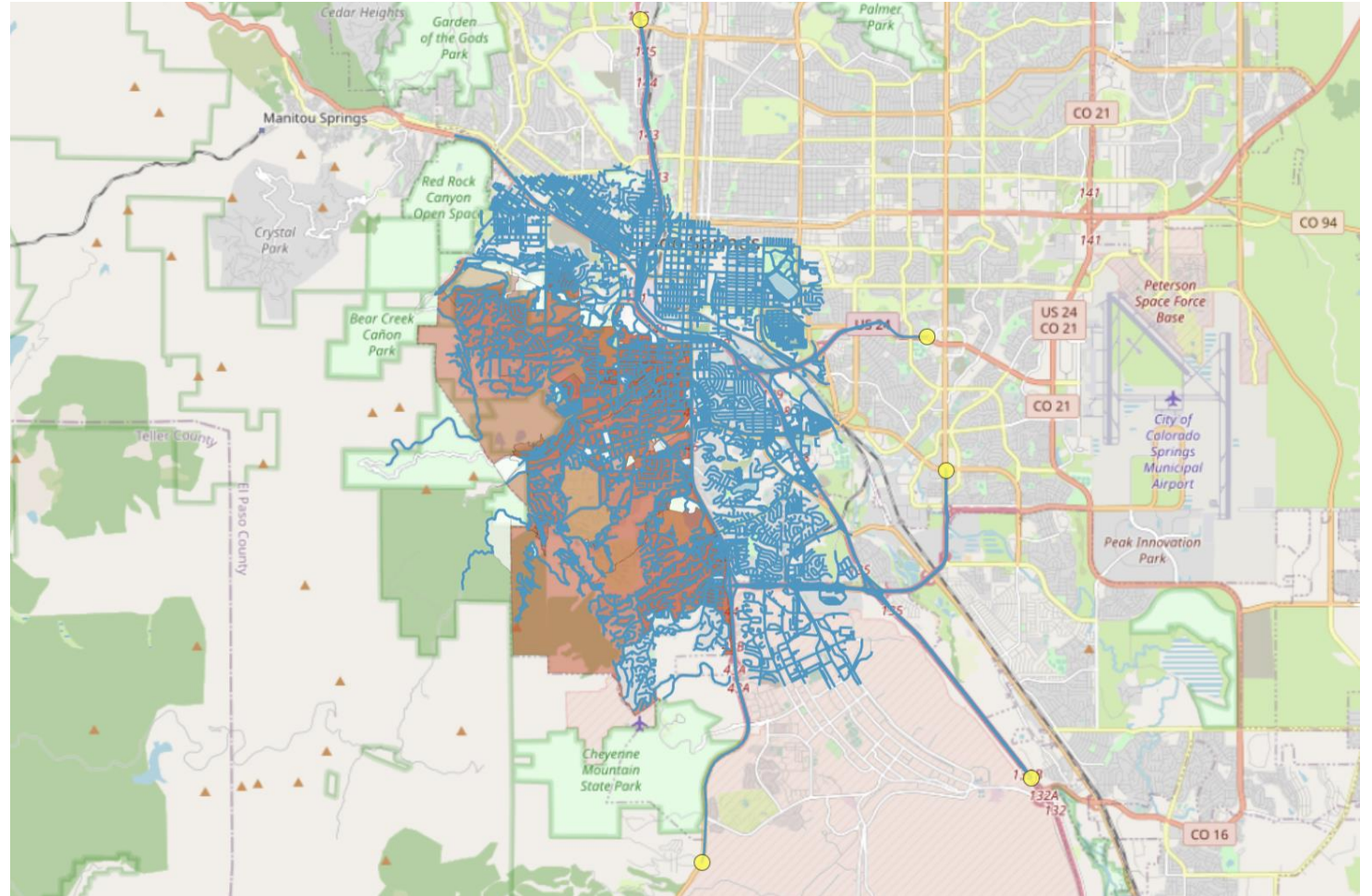
# District One Simulation Key Take-Aways

- Staged evacuations allowed westside evacuees a greater margin of safety but did NOT shorten total clearance times

- Contraflow provided meaningful improvement only when zones 1-N2 and 1-N3 both delayed evacuation start for one hour with 1.5 ppv – contraflow reduced total clearance time by forty minutes

- Average individual vehicle travel time by evacuees exceeds 2:20

  - Longer than reported following the Waldo Canyon Fire (approximately 1:40)

  - 15% increase in population

  - No early evacuees considered

- More than one vehicle / household greatly extends evacuations

# "Broadmoor" District

Selected scenarios included evacuees from:

- Seven Falls satellite parking (400)
- Cheyenne Mountain Zoo (2000)
- Broadmoor Resort (14,000)

Reductions in traffic flow were simulated on W. Cheyenne Blvd and CO 115 (individually)



Yellow nodes indicate evacuee destination points

*Resident Evacuation Plus Three Seasonal Additions*

# "Broadmoor Region" Evacuations

Scenarios included:

- 100% resident participation rate. Population was increased by 15% from 2010.

- All residents started evacuations at hour zero. Response rates were the same for all residents for each run.

- Vehicle occupancies for residents were either 2.5 ppv or 1.5 ppv

- Evacuees from the Broadmoor Resort and Cheyenne Zoo were modeled with 4.0 ppv. Evacuees from Seven Falls satellite park were modeled with 2.0 ppv.

- 12,000 vehicles of background traffic from outside the evacuation zones

- Shadow evacuees

- No origin-destination travel westbound across I-25

- No incidents were modeled (conservative time assessment)

# Broadmoor Region Simulation Results

- Most impactful delays occur at east side bottlenecks, especially on roads that would allow access to CO 115

- Extensive backups on Cheyenne Blvd and Cheyenne Road

- Simulated flow reductions on W. Cheyenne Blvd and CO 115 increased evacuation clearance times by less than one hours. Overall times were controlled by congestion at region exits.

- Shortest evacuation clearance time with 2.5 ppv, residents only: 2:30

- **Evacuation clearance time with 1.5 ppv (residents only, no incidents): 3:50**

- **With tourists**, evacuation clearance times increase to over 5 hours (1.5 ppv)

- Total clearance times were controlled by available road capacities. Extending response times from 1- to 2-hours had little impact on congestion delays.

# Broadmoor Region Key Take-Aways

- Resort evacuees, and to a lesser extent evacuees from Cheyenne Zoo, have significant impact

- Average individual vehicle travel time by evacuees at 1.5 ppv with Resort traffic exceeds three hours. Typical rush hour travel from Red Rock Canyon Open Space to Hancock Plaza is 15-30 minutes.

- More than one vehicle / household greatly extends evacuations (2015-2019 Colorado Springs average household included 2.52 persons)

- Only three tourists/guest sites were considered. The many other such sites, if added, would be expected to significantly extend clearance times since key roads are already congested.

# Summary

- Reduction of traffic flows (e.g., incidents, construction, visibility, etc.) on planned evacuation routes significantly increases evacuation clearance time

- Contraflow helps move western side evacuees away more quickly but overall travel times are controlled by congestion to the east

- Seasonal population increases (resorts, parks, zoo) greatly increase clearance times. Existing roads are not capable of large volume increases.

- Using 2.5 ppv assumes every household uses only one vehicle (average HH owns 1.8 vehicles). Leaving behind a major capital asset unlikely.

*Colorado Springs Evacuation Clearance Time Estimates Summary*

# FLEET Contacts

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# Choosing the ppv Value

- Colorado Springs population includes 37% households (HH) with 1.3 pphh

- Remaining population averages 3.2 pphh

- Average family size of 3.1

- 19% of the population represents 37% of the HH

- Assume each HH evacuates in one vehicle

- For a population of 457,325 (181,478 x 2.52):

  - At 2.5 ppv, total population would use 182,930 vehicles

  - The 19% group uses 66,554 vehicles

  - Remaining population (370,805) would use 116,376 vehicles (3.2 ppv – just one vehicle per HH)

  - If just 1/3 of these use 2 vehicles, requires 4.5 ppv for this group to have 2.5 ppv ave
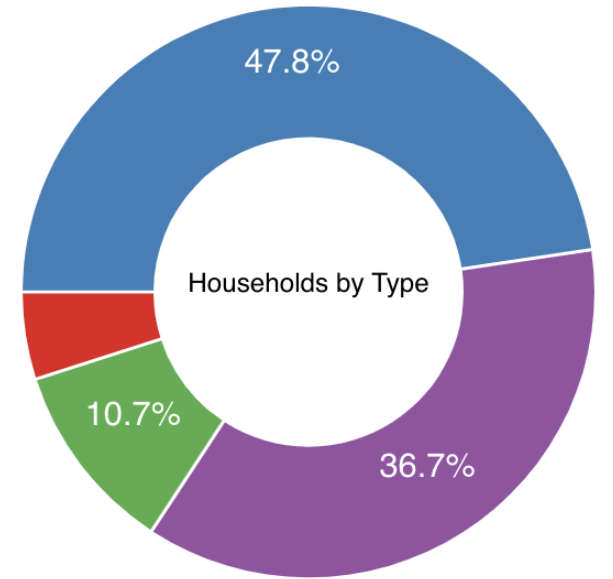
*People per Vehicle – Key Entry Value*

# Household Statistics

**Colorado Springs Households by Type**

| Type | Count ▼ | Average Size | Owned |
|------|---------|--------------|-------|
| All | 181,478 | 2.52 | 59 |
| Married | 86,713 | 3.19 | 75.3 |
| Non Family | 66,554 | 1.32 | 44 |
| Female | 19,501 | 3.28 | 44.7 |
| Male | 8,710 | 3.32 | 44.9 |

**3.1** Average Family Size

**2.52** Average Household Size

Households by Type

47.8%

36.7%

10.7%

🟦 Married 🟥 Male 🟩 Female 🟪 NonFamily

*Household Type*